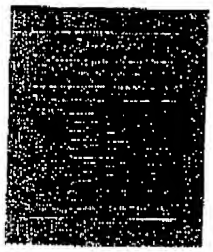
EXHIBIT B



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Article

Water content of hydrophilic phenol-formaldehyde resins: Vapor pressure-temperature relationships

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Abstract

The significance of the water content to the physical properties of phenol-formaldehyde resins at various stages of preparation is briefly discussed. Available methods for the determination of water in such resins were found to be either unreliable or too elaborate for process control. It was undertaken to develop a simple, rapid, relative method for the continuous measurement of water content which can be used to follow the follow the process of dehydration and to indicate the end-point which will result in the best dispersion of water in the cured resin. In order to standardize or calibrate such a relative method, it was necessary also to develop an absolute method for the analysis of water in the resol.

The composition of a homogeneous mixture of liquids is reflected by its vapor pressure-temperature relationships. During dehydration at 80°C., the vapor pressure of the resol decreases about 350 mm. of mercury. A very sharp increase in the slope of the vapor pressure curve occurs at approximately the proper degree of dehydration. At this stage a slight decrease in water content causes a very large decrease in vapor pressure. The sharp inflection in the curve is attributed to the existence of both "free" and "bound" water in the resin.

During the process of vacuum dehydration of the resin, while the "free" water decreases to approximately one-eighth of its original content, the "bound" water remains substantially constant. The binding of water is attributed to the methylol groups of the resol molecules and its release during the cure or hardening of the resin is considered to result from the conversion of these groups to methylene linkages.

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